NINETEENTH FUSION ENERGY CONFERENCE

SESSION EX/C5 & TH/8

Saturday, 19 October 2002, at 11:00

Chair: E.P. KRUGLYAKOV (Russia)

SESSION EX/C5 & TH/8: Helical Systems and Spherical Tori

Paper IAEA-CN94/EX/C5-1 (presented by Y. Nakamura)

Discussion

F. Wagner: I would understand impurity accumulation in a density window as follows: (1) At low density, the Ni concentration in the core increases, affects the thermal balance and flattens the T_e profile. (2) As a consequence of decreasing T_e gradient and loss of thermal diffusion, the n_e (and n_i) profile peaks. (3) With the peaking of the n_i profile, impurities accumulate. (4) At higher density, the edge ion source is increased, which maintains a flat density profile and diminishes the thermal diffusion effect of the core. Please comment on this scenario.

Y. Nakamura: I agree with you concerning the temporal process of impurity accumulation. However, we focus on impurity transport at the start-up phase of impurity accumulation. In LHD plasmas, the density profile is very flat in all operational regimes with gas puffing. Therefore, inward convection due to density gradient is negligible. From neon gas injection experiments, the radial electric field seems to be responsible for impurity accumulation. This is not completely clear, so we need further investigation.

Paper IAEA-CN94/EX/C5-2 (presented by B.P. Leblanc)

Discussion

R.J. Buttery: In your calculations of the H factor, do you exclude fast particles? What is your best estimate for the H factor?

B.P. Leblanc: In these calculations, which use outputs from the EFIT code, no attempts were made to remove fast particle effects. But we believe these results to be nevertheless applicable since TRANSP calculations show that while 25–30% of the stored energy is in the form of non-thermal ions, about the same fraction of the injected neutral beam power is lost through charge exchange and bad orbits. The “H” factor shown remains around 1.5 when TRANSP data are used instead of EFIT.

Paper IAEA-CN94/EX/C5-4 (presented by R. Brakel)

Discussion

S. Morita: The minor radius of W7-AS is relatively small. The neutral effect becomes large. What is the relation to the IOC mode in a tokamak and the reheat mode in a helical device?

R. Brakel: The reheat mode appears after switching off the gas puff in NBI heated discharges. In contrast, the HDH mode requires a permanent gas puff to sustain the density.

R.J. Hawryluk: Congratulations on the excellent HDH results. I would like to put these new results in context with previous results. W7-AS has previously reported $\tau_E \sim 70$ ms. The confinement times reported here are lower. Please comment as to why, and on what the ISS95 scaling factor is.

R. Brakel: The highest confinement times in W7-AS are 50–60 ms. They have been achieved in the “optimum confinement” regime with moderate heating of about 1 MW and in configurations with a large plasma radius of about 18 cm. Taking the power degradation and the a^2 scaling of confinement into account, these differences explain the lower confinement time in HDH. Compared with the ISS95 scaling, both regimes exceed the scaling by a factor of about 2.

Paper IAEA-CN94/TH/8-1 (presented by P. Helander)

Discussion

R.J. Goldston: Possibly even less well known than the PRL on ion runaway is the confirmation of the E_* effect on the ATC tokamak. In 1974 or thereabouts, we published results showing that the energetic ion tail above the NB injection energy differed in the co vs. ctr direction, consistent with E_*.

P. Helander: Over the years, there have been a number of observations of pre-existing fast ions accelerated by the field induced by an instability, but I believe our experiments on MAST are the first where a tail is pulled out from the thermal population.

D.D. Ryutov: At a high runaway current of ~1 MA as seen on JET, one could expect the development of various kinetic instabilities which, according to theory, have very high growth rates. Why do they not show up in the behavior of runaways?

P. Helander: We have not made any detailed analysis to clarify why these instabilities do not appear to play any role in these discharges. The theory seems less well developed for strongly relativistic runaway populations, such as those in JET, than for the non-relativistic case.

A. Ejiri: Could you comment on impurity ion heating or cooling.

P. Helander: Theoretically, impurity ions are expected to be accelerated in the opposite direction from the bulk ions.

P.C. Efthimion: Do you have measurements of high harmonic synchrotron radiation to verify that this emission is responsible for damping the runaway electrons?

P. Helander: No. As far as I am aware, no such diagnostic information was available for these discharges.